UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL

Distr.
GENERAL

E/ECA/NRD/ERU/COAL/250/E/86
10 March 1986

ORIGINAL: ENGLISH

ECONOMIC COMMISSION FOR AFRICA

COAL IN AFRICA - BASIC PROPOSALS FOR THE DEVELOPMENT

EDUCATION AND MANAGERIAL TRAINING FOR INCREASED COAL UTILIZATION

COAL IN AFRICA - BASIC PROPOSALS FOR ITS DEVELOPMENT

EDUCATION AND MANAGERIAL TRAINING FOR INCREASED COAL UTILIZATION

Table of Content

		Page
1.	SUMMARY AND RECOMMENDATIONS	1
2.	BACKGROUND AND INTRODUCTION	4
3.	GENERAL PRE-REQUISITS FOR COAL MINING RELATED EDUCATION AND MANAGERIAL TRAINING	5
4.	EXISTING FACILITIES ON A SUBREGIONAL LEVEL (SOUTHERN AFRICA)	8
5.	EDUCATION AND MANAGERIAL TRAINING IN THE FRAMEWORK OF TECHNICAL AID	8
6.	RECOMMENDATIONS FOR REGIONAL AND INTERNATIONAL INSTITUTIONS	12
7.	POLICY ISSUES	14
8.	LIST OF REPORTS AND DOCUMENTS	15
9.	ABBREVIATIONS AS USED IN THIS REPORT	19

1. SUMMARY AND RECOMMENDATIONS

1. This publication deals with the education and managerial training aspects of increased coal mining in Africa. It takes, however, only into consideration the education and training requirement for senior and intermediate management as it is initially and predominantly needed for government services while those for operations, respectively for operational management and labour force are left at this stage to later activities as to be directed by the employed operating companies in the overall framework of the actual development of coal mining projects.

2. As explained in more detail elsewhere (58), the requirement of endowing the government of a developing country with expertise to successfully and efficatiously participate in a major coal project, to fulfill its obligations and to exert its rights as a possible project partner, appears to be of foremost importance. While initiating new or increased coal mining, a government should above all be in the position to introduce and to enforce appropriate mining legislation and to see to it that private industry fulfills its financial and other obligations under the law.

3. There are only a few mining related educational and training facilities in Africa, respectively in Southern Africa (outside South Africa) that are available for utilization and further expansion under longterm aspects. At the present time they do not suffice in order to professionally and effectively backing up the required increased coal mining development in the sub-region or in the region.

4. There is no doubt that the creation of an educational infrastructure for supplying a rising mining industry in industrially developing African countries with sufficiently qualified, experienced and capable managers and engineers for successfully increased or new coal mining requires a time frame of rather decades than years. In the interest of an expeditious industrial development it will therefore not be avoidable to avail oneself in the meantime of experienced international operating companies and of industrial nations' technical aid potentials as successfully experienced by certain Southern African countries in their recent history.

5. A technical aid project for the education and training of a sufficient number of persons for the major disciplines of the respective coal development in an African country including the essential staff for government agencies should consider the varying educational potentials of donor countries with respect to the various facets of the future enterprise. Advantage should be taken from existing achievements and facilities in donor countries with respect to College and University education and to practical management training. But not too rigid a specialization should be pursued.

6. Specific attention must be addressed to the necessity of post-graduate training in supervisory and management functions, preferably in operations of adjacent countries in the respective sub-region. This would urgently be required before the young engineers were released into their government and management functions for which they were selected. The time requirement for such a systematic education and training programme is shown in the graph of figure 5.1 and covers several years consisting of practical work in mines, of studies in Colleges and Universities and of managerial training in suitable operations.

7. The essence of this assessment is that the expectations for a rapid development of the mentioned managerial potential for coal mining development should not be too overconfident. A lengthy, however, comprehensive and major effort is required which should be based on the following foundations:

a) Until the final development of sufficiently qualified management cadres, i.e. during the next 10 to 20 years, major coal mining development should make use of available expertise vested in industrialized countries and in the international operating companies and buy this expertise;

b) Major technical aid programmes for education and Management training should be initiated in co-operation with industrialized countries in which adequate education and training facilities for the upbringing of future coal mining engineers and managers are available; the experiences gained from successfully executed models should be used.

c) The coal mining related facilities of existing Universities in a Subregional should be utilized as far as possible as a foundation for further education and training development.

8. The United Nations University proposed the establishment of an Institute for Natural Resources in Africa (INRA) as a high calibre research and training centre. Six priority programmes are outlined according to the Lagos Plan of Action of which those for Land use, Water Resources, Plant Resources and Mineral Resources will be carried out in Abidjan, Ivory Coast. The Mineral Resources Department will be placed in Lusaka, Zambia, where the existing School of Mine will be the focal point for further development of the mineral mining sector with assistance from McGill University in Canada.

9. The United Nations University has not yet proposed a final location for the Energy Unit within INRA. According to the above presented information and assessment and under the aspect that coal will have to play a major role in the development of African industrialization, it would appear to be prudent:

- to locate the Energy Unit in the close vicinity of the Mineral Resources Unit;

- to station it in a country where at least two of the major energy sources e.g. Hydro and Thermal Power, i.e. predominantly coal, are located;

- to place the Energy Unit in a country where the application of the major energy sources has already partly been optimized by applying coal for industrial and agricultural purposes, e.g. as for tobacco and tea drying, rather than using exclusively wood fuel; and

- to locate it in a country where successful coal mining takes place by underground mining methods and by openpit operations' and where the optimization of powergeneration with steamcoal and the production of coking, coal and coke has already been materialized; Furthermore

- to establish the Energy Unit within the framework of an existing university, where coal mining technology is already being tought and where an effectively functioning mining curriculum and appropriate laboratories, etc., are available for further development and expansion;

- finally does it appear to be of paramount importance that the selected place should already be embedded in a well functioning industrial infrastructure in order to support the scientific activities of the institution by pragmatic industrial action and application which could efficaciously enhance the up-bringing and activation of capable industrial managers.

10. Similar to the sponsorship of the MacGill University in Canada for the Mineral Resources Unit in Lusaka, one or more internationally renown University(ies), where Energy and specifically coal mining are highly ranking, should be approached for international assistance.

11. The Energy Unit of INRA should expeditiously be initiated and provided with the necessary personnel and material endowment in order to build up a high ranking education and training facility in Africa for the upbringing of as many as possible highly qualified energy and specifically coal mining engineers, who as post graduates will then initially grow into their responsibilities and functions in the meanwhile employed international specialized corporations. After having received enough training as managers "in a competitive industrial environment where high efficiency and cost effectiveness are of permanent importance" (25) they will subsequently become the leading technical and administrative executives and engineers of the developing African Energy and coal mining industry.

2. BACKGROUND AND INTRODUCTION

12. UNECA concluded an Agreement with the Federal Republic of Germany in August 1984 for the delegation of an expert on coal development in order to enhance coal development in Africa and to pursue the following objectives:

- To actualize the intended inventory on coal resources, production and trade in Africa;
- To give advice and to assist member States in their endeavour to substitute environmentaliy destructive wood consumption and expensive coal and oil imports by the establishment of indigenous coal production; and
- To advise and to assist member States in their plans and actions to develop coal production facilities for coal export purposes where feasible.

13. The author was delegated from the Federal Republic of Germany to UNECA in Addis Ababa as a Regional Adviser for the development of African coal resources under the mentioned agreement.

14. This report represents the fourth part of a sequence of publications under the collective topic "Coal in Africa - Basic Proposals for its Development" and deals with the aspects of:

- "Education and Managerial Training for Increased Coal Utilization".

Previously published reports under the mentioned collective topic are:

- "Inventory and Assessment of African Coal Resources, Production and Trade in the Context of Regional African Development" (as presented by UNECA during the Regional Workshop on Energy Supply and Demand Projections through 1985-1990 in Africa, 25-29 November, 1985) (41).
- "Coal potential and possibilities for Increased Coal Utilization in Africa (as having been issued by UNECA as a Report to the Conference of Ministers of the UNECA member States in Yaounde, Cameroon, in April 1986 and as a technical publication under the subprogramme on the Integration of Energy policies into overall socio-economic development and growth policies (52), dated 12 December 1985, and
- "Operational and Organisational Aspects of Increased Coal Utilization in Africa (issued by UNECA as a technical publication under the aforementioned subprogramme) (58), dated 23 December 1985.

15. Mainly based on the operational and organizational aspects of increased coal utilization, this publication considers the requirements for education and managerial training in the context of the development and increase of successful coal mining in African member States. The basic proposals contained in this report are, however, based on two missions undertaken to Southern African States and will have to be complemented by the results of further missions to North, West and Central African countries.

3. GENERAL PREREQUISITS FOR COAL MINING RELATED EDUCATION AND MANAGERIAL TRAINING

16. It would exceed the frame work of this presentation if an attempt was to be made to deal with all training and educational aspects of increased or new coal mining in Africa, largely on a grass roots basis. A comprehensive consideration of education and training aspects of increased or new coal utilisation would have to take into consideration the following aspects:

17. Senior and Intermediate Management comprising the following disciplines:

- Overall Direction of Operations and Mining Administration,
- Finance,
- Personnel
- Transport and Trade,
- Information,
- Mining Operations,
- Coal Preparation and Load out Facilities,
- Engineering and Technical Services,
- Safety and Security,
- Planning and Services
- Supply
- Medical;

- Lower Management and Labour Force comprising likewise the afore-mentioned disciplines, but in its majority concentrating on:

  - Mining Operations,
  - Coal Preparation and Loadout Facilities, and
  - Technical Services;

- The Bulk of the Manpower consisting of:

  - Articans,
  - Semi Skilled and
  - Unskilled Labour

18. The education and managerial training requirements as shortly outlined here confine themselves to the issues as necessarily to be borne to the part of a coal mining project of which the main objective is to provide a government with the potential to successfully participate in such a project under long term aspects. This means, it must sufficiently be endowed with expertise to fulfill its obligations and to exercise its rights as a possible project, respectively a joint venture partner and to introduce and to enforce appropriate mining legislation and see to it that private industry fulfills its financial and other obligations under the law.

19. Not included into this outline are consequently training and education requirements of lower management and labour force that will later on be necessary to bring final success to the mining and to the infrastructure operations of a coal mining project after its implementation. This issue has to be addressed and defined in the terms of reference for the mining and infrastructure operating company(ies) within the joint venture or co-operation contracts, i.e. during the later part of the Pre-feasibility Phase (see 58). It will have to be a substantial part of the tender stipulations for the selection of the operating company(ies). The project partners will have a vital interest to create and to raise a labour force and management on all levels that would be grown up to safeguard optimum performance in connection with the chosen equipment and management principles. Consequently, it will partly be an issue which the mining industry will have to deal with.

20. On the other hand, it will, of course, not entirely be left to the initiatives of the operating company(ies): the state will exercise its right to help structuring training and facilities, and it will largely depend on the experience and expertise of the selected operating company(ies) how such a training programme will be structured under long-term aspects and which role and contributions in later phases of the project will finally be rendered by the Government and/or by possibily involved international organizations and or donor countries (54).

21. The educational standard within a country where a coal mine is to be developed plays an important role with respect to the aspired success (54). In some cases the educational status quo with respect to primary, secondary, college - and university education does not fully suffice in order to base on it successfully continuing mining related education and training.

22. According to the above defined concentration of the presentation on Senior and Intermediate mining management as mainly required for governmental assignments, the education and training prerequisits corresponding to only these job levels will be dealth with in the following sections. Also for these job levels will it be of importance for the success of a new or expanded mining enterprise, to which degree existing education and training facilities and institutions can be exploited and expanded on a regional and subregional basis for the development of an efficient and efficatious coal mining management and administrative cadre.

23. There is no illusion that the creation of an educational infrastructure for supplying a modern mining industry in a developing country with sufficiently qualified, experienced and capable managers and engineers for successful coal mining and governmental supervision requires a timeframe of rather decades than years (52,53,54 & 25 et al.). The disastrous results of attempts to operate a mine in the absence of qualified technical management should be prohibitive for any further wasted monies and efforts. It should be understood as well that not only education and university training are sufficient to effectuate the aforementioned managerial potential, but that many years of lower, middle and superior management training in a competitive operational environment are required in order to lead to managerial and administrative success in mining, specicifically in coalmining (25). There is no doubt that such an environment may rather be found in industrialized countries and in multinational operating companies than in developing countries at the present average industrialization standard nor can it be expected here in the intermediate term future.

24. There is furthermore no doubt that the education and training requirements alone for governmental staff, as needed for large scale export coal mining and medium scale coal mining, represent only "the tip of the iceberg", and that a multiple number of professional engineers, technicians, administrators, geologists, and coal market specialists etc., would be required if the existing dependency on donor countries and multi-national mining operators and their expatriate staff was gradually to be reduced under long term aspects.

25. The overall development status of existing African education and managerial training facilities does obviously not suffice at the present time to meet the relevant pre-requisits of seriously increased coal utilization. In many cases, it will not be avoidable to avail oneself of the existing international expertise vested in specialized operating companies and of industrialized nations' technical aid potentials as very successfully used by certain Southern African countries (56, 53,45). We will return to this issue further below.

4. EXISTING FACILITIES ON A SUBREGIONAL LEVEL (SOUTHERN AFRICA)

26. According to the present status of the work in which only Southern African member States have been visited (see Section 2, Background and Introduction), a discussion on existing facilities is consequently restricted to the sourthern subregion of the continent. There are only a few mining related educational and training facilities in Southern Africa (outside South Africa) that are available for utilization according to their existing potential and qualification with respect to coal mining (54). The Bulawayo School of Mines in Zimbabwe as part of the Bulawayo Technical College is holding courses for Mining, Mine Surveying and Mineral processing technicians, and the Institute of Mining Research at the University of Zimbabwe is offering courses for Mining Engineering with the possibility to acquire Bachelor and Master degrees in Mining Engineering. Moreover, there are already coal quality laboratory facilities in Harare (Geological Survey) which could be complemented, utilized and expanded for increased Southern African coal mining development. However, the lack of trained and experienced technicians and coal quality engineers is still a severe handicap.

27. There is no doubt that the mentioned facilities do not yet suffice in order to professionally and effectively backing up major new coal mining development projects in the subregion and that there are drastic measures required to either upgrade the existing or to create new facilities which could serve these coal mining developments that are potentially possible in the Subregion (see 45,52,53,54, 58).

5. EDUCATION AND MANAGERIAL TRAINING IN THE FRAMEWORK OF TECHNICAL AID

28. In view of the foregoing and in the interest of an expeditious increase of African coal utilization, all possibilities of international co-operation, specifically with industrialized countries, where ample experience, education and managerial training possiblities are prevailing, should be exploited.

29. During the initial phases of a major project parallel to the elsewhere described project phases and activities (58) a broadly based long-term technical aid programme for managerial training and education should be planned, initiated and carried out in order to gradually develop the required governmental manpower infrastructure in time for regulating and supervising such project in the long run.

30. As mentioned above, this programme would concentrate on the education and training of medium and high level administrative, supervisory, engineering, and management personnel as mainly required for governmental services. Such a long-term training and education programme could initially be carried out within one or more donor country(ies) until the necessary potential of mining related colleges and universities will have been developed in the developing country or

within the subregion. The experiences in similar mining related training and education projects in Africa should present practicable guidance in order to secure final success (57).

31. Such a programme will be long-term oriented and will not be directed towards details of the project during its initial phases. Its objective will be to educate and to train a sufficient number of persons for all major disciplines of the coal development venture, specifically for the required staff in government agencies in order to provide the venture with as many qualified specialists as necessary and as expeditiously as possible. This programme would have to be elaborated in close co-operation between all concerned taking into due consideration the existing education potential in the country itself and within the Subregion and Region, as well as the educational necessities for the future staff. All facets of the project and possibly of the export entity will have to be considered (see 58).

32. It is furthermore important to consider the varying educational potentials of certain donor countries with respect to the various facets of the future enterprise. For example, a mining engineer who was envisaged to play a leading role in the future openpit operation would not necessarily have to become specialized in sophisticated underground long wall technology. Due regard must be given to the foreseable practical requirements of the future operations. However, not too rigid a specialization can be allowed despite the necessity to economize on time and monies to be spent for universal studies.

33. Time will be of the essence in such an educational and training programme. And probably a suitable combination of donor countries should be selected for providing education grants and training possibilities. A few examples should be given here stemming from the author's personal experience. No claim to completeness is indicated here:

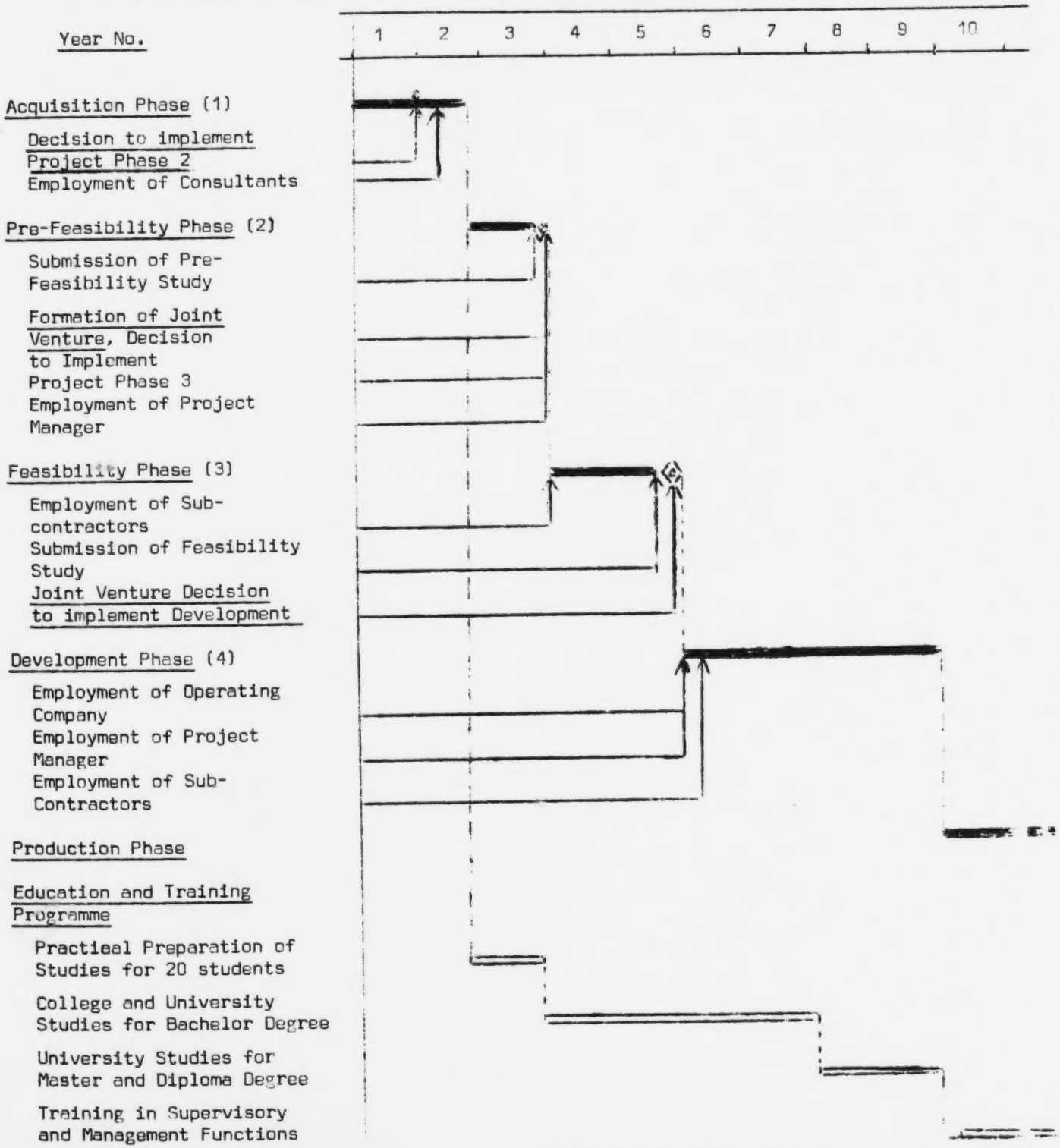
- Germany with its sophisticated coal and coke quality -, preparation, and iron and steel production facilities could render educational and training assistance specifically in these fields;

- Canada with its Western openpit coal mining operations that resemble very closely the conditions which could be encountered in Southern Africa could be of assistance in this respect. Also her profound experiences in unit train transporation and modern bulk harbour facilities could be helpful;

- The United States and Western Europe could be approached to render educational and training assistance in the areas of modern River barge transportation systems (on the sourthern Mississippi and on the river Rhine). It should be borne in mind that theoretical studies at colleges and universities must go hand in hand with practical work in suitable industries during the periods between the study semesters or trimesters.

Figure .5.1

Simplified Bar Chart
for the Project Development of a major Coal Export Potential in Southern Africa



Legend: ◆ Point of major Decision

Point of Decision to Implement the Project (Point of no Return)

34. Specific care should be exercised towards mentoring the students to help them overcome changes of environment, culture and climate and to assist them in overcoming physical and psychological hardships. The successful experiences gained in similar education and training programmes of the past should carefully be studied and exploited in order to avoid mistakes and to optimize the output of such a programme as much as possible (57).

35. Specific attention must be addressed to the necessity of subsequently following postgraduate training in supervisory and management functions preferably in mining operations of adjacent countries in the subregion. This would urgently be required before the young engineers were to be released into their Government functions for which they were selected. It is assumed that such a practical management training pays for itself.

36. As shown in the graph of Figure 5.1, the required duration for such a managerial education and training programme covers, in fact, a very lengthy period of time. For example, the time frame of the Pre-Feasibility Phase (see 58) would only cover the practical experience gathering of the students, which would last for at least one year, concurrently with the anticipated duration of the Pre-Feasibility studies of a specific project. Theoretically, in case the project should not proceed thereafter, the education programme could be curtailed. However, even in case of postponement or cancellation of a project, it appears to be justified to continue the education process and to regard this as a technical aid programme of its own. Such expertise will be required for any kind of mining and infrastructure related projects in the respective developing country or within the subregion.

37. It is presumed that for the Government's functions within a project of several million tonnes capacity per year approximately 20 students will have to be sent to industrialized countries, where they will first acquire practical experience, working in various labour functions in mining, coal preparation and coking plants as well as in steel mills, in coal transporation, in harbour facilities and laboratories. This minimum duration of one year will also be used for language evening courses if required. It is furthermore presumed that Bachelor or Graduated Engineer exams will require 4 years study time. At least twelve students are supposed to reach a Bachelor or Ing. Grad. degree. Eight students may be expected to reach a Masters or Dipl. - Ing. degree. The time requirements herefor are estimated to take 6 years. Monitoring and Supervising the progress of studies will be necessary to assure success and to minimize dropouts. The required mentors will have to be recruited from industries, colleges and universities of the donor country. The Chief Technical Adviser of a technical aid project and the Government representative of coal development of a developing country should carry out a half time check-up visit to the countries and students concerned.

38. Only sufficiently educated and experienced local engineers as obtained from the described education and training programme can replace the temporary employed expatriate experts that fill the existing gaps in a governmental agency often in advisory functions, for the supervision and regulating of a new coal mining development. This means, according to the graph of Figure 5.1, approximately after 10 years, i.e. probably only after the project's implementation.

39. The essence of this assessment is that the expectations for a rapid development of the mentioned managerial potential for coal mining development should not be too overconfident. A lengthy, however, comprehensive and major effort is required which should be based on the following foundations:

(a) Until the final development of sufficiently qualified management cadres, i.e. during the next 10 to 20 years, major coal mining development should make use of available expertise vested in industrialized countries and in the international operating companies and buy this expertise;

(b) Major technical aid programmes for education and management training should be initiated in co-operation with industrialized countries in which adequate education and training facilities for the upbringing of future coal mining engineers and managers are available; the experiences gained from successfully executed models should be used (57);

(c) The coal mining related facilities of existing Universities in a Subregion should be utilized as far as possible as a foundation for further education and training development, e.g. the Institute for Mining Research at the University of Zimbabwe and the Bulawayo School of Mines in Southern Africa.

6. RECOMMENDATIONS FOR REGIONAL AND INTERNATIONAL INSTITUTIONS

40. The United Nations University proposed the establishment of an Institute for Natural Resources in Africa (INRA) as a high calibre research and training centre (55). Six priority programmes are outlined according to the Lagos Plan of Action:

1. Land Use
2. Water Resources
3. Plant Resources
4. Animal Resources
5. Mineral Resources
6. Energy

41. While the Location for the Institute as far as agriculture and Water Resources are concerned, will be in Abidjan, Ivory Coast, the placement of the Mineral Resources Department will be in Lusaka, Zambia, where the School of Mine will be the focal point for further development of the mineral mining sector with assistance from McGill University in Canada.

42. The recent publication of the United Nations University does not yet propose a final location for the Energy Unit within INRA (55). According to the above presented information and assessment and under the aspect that coal will have to play a major role in the development of African industrialization, it would appear to be prudent:

- to locate the Energy Unit in the close vicinity of the Mineral Resources Unit (Mining is similar and professors could commute),

- to station it in a country where at least two of the major energy sources, e.g. Hydro and Thermal Power, i.e. predominantly coal, are located, oil does not appear to be exigently decisive because this source of African energy is mainly meant to be exported while coal must necessarily be developed for African use in Africa in order to alleviate certain emergency situations (see 58 and 52),

- to place the Energy Unit in a country where the application of the major energy sources has already partly been optimized, e.g. by applying coal for industrial and agricultural purposes, e.g. as for tobacco and tee drying, rather than using exclusively wood fuel; and

- to locate it in a country where successful coal mining takes place by underground mining methods and by openpit operations; and where the optimization of powergeneration with steamcoal and the production of coking coal and coke has already been materialized (53), Furthermore

- to establish the Energy Unit within the framework of an existing university, where coal mining technology is already being tought and where an effectively functioning mining curriculum and appropriate laboratories, etc., are available for further development and expansion;

- finally does it appear to be of paramount importance that the selected place should already be embedded in a well functioning industrial infrastructure in order to support the scientific activities of the institution by pragmatic industrial action and application which could efficaciously enhance the up-bringing and activation of capable industrial managers.

43. Similar to the sponsorship of the McGill University in Canada for the Mineral Resources Unit in Lusaka, one or more internationally renown University(ies) where Energy and specifically coal mining are highly ranking should be approached for international assistance.

7. POLICY ISSUES

44. It appears to be prudent to initiate the Energy Unit of INRA expeditiously and provide it with the necessary personnel and material endowment in order to build up a high ranking education and training facility in Africa for the up-bringing of as many as possible highly qualified energy and specifically coal mining engineers, who as post graduates will thereafter grow into the responsibilities and functions in the meanwhile employed international specialized corporations. After having received enough training as managers "in a competitive industrial environment where high efficiency and cost effectiveness are of permanent importance" (25), they will become the leading technical and administrative executives and engineers of the developing African Energy and coal mining industry.

45. It goes without saying that in the interest of a rapid and effective build-up of the mentioned Institution, policy issues should indeed not be neglected, however, they should certainly not encumber the expeditious creation of an efficaciously working energy related regional African education and training centre. Also the horizontal co-operation with other African energy institutions and UN related technical centres will be required as well as the exigent vertical integration of research and teaching into international connections in the interest of keeping up-to-date with international innovations, which will for a certain time to come, still progress faster in industrialized than in developing countries. There is no doubt that such a realistic and pragmatic approach will help rendering the new institution to become effective for the long-term benefit of African people.

8. LIST OF REPORTS AND DOCUMENTS

That were available to the author and which have been used for the elaboration of this report. The sequence of the numbers indicate the sequence during the preparation of the various sections.

1. UNDP/World Bank: Botswana, Issues and Options in the Energy Sector, 1984.

1a, Botswana Department of Mines, Annual Report, 1983

2. Estimates of the author, based on personal information during recent missions in 1984 and 1985.

3. Department of Geological Survey: The Coal Reserves in Botswana, 1984.

4. Malawi Geological Survey: various publications by J. Chatupa, 1983/84.

5. UNDP/World Bank: Malawi, Issues and Options in the Energy Sector, 1982.

6. UNDP Country Report Mozambique, 1985.

7. UNECA: Current Status and Future Prospects for the Development of Coal in Africa, 1983.

8. N.M. Murray and A. Granville, Mineral Bureau of S.A. (German) Magazine Glueckauf 118 (1982) No. 4: The Coal Mining Industry in South Africa (German Language).

9. Mining Annual Review, published by Mining Journal, London, 1985, 1982, 1981.

10. Mining Journal, London, March 1985.

11. P.J. Hugo, Minerals Bureau, Johannesburg: The South African Coal Industry, June 1983.

12. W.S. Lyimo, Tanzania Ministry of Minerals: Tanzania Coal Development, June, 1983.

13. A.O. Mansur, Egyptian Geological Survey: An Assessment of the Potential of Coal Deposits in Egypt, and Future Prospects, June 1983.

14. UNECA: Various documents from the Regional Workshop on "The Role of Coal in Accelerated African Economic Growth", July, 1983.

15. H.J.K. Koeser, W. Siemens: The Mining Economy in the Republic of Niger, (German) Magazine Glueckauf 1985.

16. Nigerian Coal Corporation: Information on the Nigerian Coal Industry, 1982.

17. Republic of Zambia Ministry of Mines, Geological Survey Department: Coal Exploration in Zambia, (1983) position and projections for the future ..

18. H.H. Palloks, Zimbabwe Geological Survey: An Assessment of Some of the Coal Deposits in North-West Zimbabwe, 1984.

19. B. Barber, Zimbabwe Geological Survey: Coal Resources and Utilization Study, 1984.

20. Montan Consulting GmbH and Zimbabwe Ministry of Mines: Final Report on Coal Resources and Utilization, Pre-Feasibility Study, 1983.

21. Wankie Colliery Co. Ltd.: Documents and Publications, 1984, 1985, (partly unpublished).

22. US Bureau of Mines: Minerals Yearbook, 1981.

23. UNDP/World Bank: Zimbabwe, Issues and Options in the Energy Sector, 1982.

24. Zaki El-Hewehi, Chemicoke, Egypt: Prospects for African Co-operation in Coking Coal for Iron and Steel and related Industries, prepared for UNECA, 1983.

25. British Mining Consultants Ltd.: Feasibility Study for the Rehabilitation of Maamba Collieries Ltd., Volume 1, Executive Summary and Financial Analysis, December 1984, (unpublished).

26. National Energy Council of Zambia: Energy Production and Consumption in Zambia 1978-1983.

26a. UNDP/World Bank:Zambia, Issues and Options in the Energy Sector, January, 1983.

27. Friedensburg-Dorstewitz: The Mining Economies in the World (in German Language), 1976.

28. UNECA et Congres Geologique International: Carte des Depos Houlliers en Afrique, 1964.

29. Barclays Botswana: An economic Survey and Businessments's Guide, 1982,

30. African Business, London, June 1984.

31. SADCC Project Proposal No. 281: Investigation of Coal Briquetting in Zambia, 1985.

32. World Coal, Vol. 7, No. 7, Nov./Dec. 1981.

33. World Bank: Study on Existing and Planned Export Coal Mines in the Republic of South Africa, 1983, (unpublished).

34. A.T. M. Mehliss: South African Coal, Energy Minerals, 1985.

35. Netherlands Economic Institute: Zimbabwe Coal Transportation Study, May, 1985, (unpublished).

36. South African Operating Companies for Coal Mines and Projects: Statistical Information on Mining Engineering and Economics of Coal Mines and projects in Swaziland, Malawi, Botswana and Zimbabwe (unpublished), 1985.

37. South African Institute of Mining and Metallurgy, Monograph Series No. 4, Increased Underground Extraction of Coal, 1982.

38. Chamber of Mines of South Africa: Ninety-Fourth Annual Report, 1983.

39. Gewerhsckaft Exploration (Exploration and Mining): Bituminous Coal in South Africa, (German language) Duesseldorf, FRG, (Unpublished), 1972.

40. Massachusetts Institute of Technology: Coal - Bridge to the Future Report of the World Coal Study, Boston, 1980.

41. UNECA, G. F. Lange: Inventory and Assessment of African Coal Resources Production and Trade in the Context of Regional African Development, 15 November 1985, ECA/NRD/ERU/COAL/280/2/85, including 40 sources of documentation which are listed before.

42. R.H. Shannon: Handbook of Coal Based Electric Power Generation, USA, 1982.

43. H.J. Laue, T. Balabanov, UNIDO: Energy Planning for Industrial Development, 1985 (not yet published).

44. Newspaper article in El Comercio, Lima, Peru, of 22 June 1985, as transferred to the Author by Grundstofftechnik GmbH, Essen, Germany, in July 1985.

45. UNECA, G.F. Lange: Conceptual Report on the Reorientation of the Strategy for a Coal Export and Utilization Project in Botswana, May 1985.

46. Organization of African Unity: Lagos Plan of Action for the Economic Development of Africa 1980-2000, 1980.

47. H.J. Mareyen, J. Brinkmann: Steinkoblenseeverkehr in der Welt (Hardcoal seagoing traffic in the World), Volks-und Energiewirtschaft, Glueckauf 121 (1984, No. 16).

48. H. Mellanby-Lee, NCB; Coal prices improve but oversupply continues, Engineering and Mining Journal, March 1985.

49. J. R. Burger: Cerrejon - Coal from Colombia, E. and M.J., April 1985.

50. SADCC Energy Project of Regional Interest: Evaluation of Export Opportunities for Southern African Coal Producers, September 1983, (not yet completed).

51. J.C. Todd: Cerrejon Profitability snags on low prices and lagging sales, E. and MJ, September 1985.

52. UNECA, G.F. Lauge: Coal in Africa, Basic Proposals for its Development, Coal Potential and possibilities for increased Coal Utilization, 12.12.1985.

53. UNECA, G.F. Lange: Summary Mission Report on a mission to Southern Africa from 9 July to 21 August 1985 for the Development of Coal Resources in: Malawi, Swaziland, Mozambique, Zambia and Zimbabwe, September, 1985.

54. SHELL COAL BOTSWANA (PTY)LTD.
Kgaswe Project Feasibility Study, 1984 (unpublished)

55. The United Nations University: Institute for Natural Resources in Africa, Prospectus, 23 August 1985.

56. UNECA, G.F. Lauge: Report on a Mission to Southern Africa from 4 November to 3 December 1984 for the development of coal resources in Botswana, Swaziland and Mozambique, December 1984.

57. CIDA Project No. 200/00905: Report on the joint mid-project Evaluation, Technical Assistance to the Government of Botswana Department of Mines, Toronto, Canada, 1983, (not published).

58. UNECA, G.F. Lauge: Coal in Africa - Basic Proposals for its Development Operational and Organizational Aspects of Increased Coal Utilization, 23 December,1985,, ECA/NRD/ERU/Coal/280/5/86.

9. ABBREVIATIONS AS USED IN THIS REPORT

ARA	Amsterdam, Rotterdam, Antwerpen
BPC	Botswana Power Corporation
°C	Degree temperature in Centigrade (Celsins)
Cbm	Cubic meter
Cby	Cubic yard
CIF	Cost, Insurance, Freight
d.b.	Dry basis
E	Emalangeni (Swaziland currency, same value in US$ as Rand)
EEC	European Economic Community
FOB	Free on Board
FRG	Federal Republic of Germany
GJ	Giga Joule, heat value (4,18706 Kcal/kg)
IDDA	Industrial Development Decade in Africa
K	Kwacha (Malawi and Zambian Currency, MK = 0.62 US$ (July 1985) ZK = 0.50 US$ (August 1985).
Kg	Kilogram (1000 gram)
Kcal/kg	Kilogram Calory per Kilogram, heat value
MJ/Kg	Mega Joule per Kilogram (4,18706 x 10^{-3} Kcal/Kg), Heat value
MS	Manshift
MW	Megawatt, heat rating
NCB	National Coal Board (UK)
NE	North-East
NOx	Nitrogen oxides (NO, NO2, etc.)
OECD	Organization for Economic Co-operation and Development
ROM	Run of Mine (Coal)
SADCC	Southern African Development Co-ordinating Conference
t	Tonne (metric 1,000 gram)
thebe	1 thebe = 0.01 Pula, Botswana Currency (1 Pula = 0.87 US$ in April 1985)
t/MS	Performance in tonnes coal per manshift.

UNDP	United Nations Development Programme
UNECA (ECA)	United Nations Economic Commission for Africa
UNIDO	United Nations Industrial development Organization
W	Watt, heat rating
Z$	Zimbabwe Dollar = 0.63 US$ (Sept. 85).